General Motors Upfitter Integration

2018

BEST PRACTICES GUIDELINE MANUAL

- INTRODUCTION
- BODY
- CHASSIS
- ELECTRICAL
- PAINT & SEALING

Index

A. Objectives 1
B. Important: A Word About This Guide 1
C. Defining the Guideline Manual 1
D. Upfitter Integration Expectations 2
E. Continuous Improvement 2
F. Key Product Characteristics 2
G. Reference Materials 3
H. Vehicle Weight 3
I. Serviceability 4
J. Torque Specifications 4
K. Special Vehicle Manufacturer's Body 4
L. Body Sealing 5
M. SVM Responsibility 5
N. Responsibility for Complete Vehicle Document 5
O. Incomplete Vehicle Document 6
P. Characteristics of a Compliance Control System 6
Q. Noise Emission Standards for Transportation Equipment:
Medium and Heavy Trucks – 40 CFR Part 205 7
R. Federal Regulations – Tires 8
S. Personnel and Process Controls 8
T. General Information 9

Introduction

A. Objectives

The objective of the UPFITTER INTEGRATION GROUP is to provide assistance to the Special Vehicle Manufacturer (SVM) to assure that converted, upfitted and modified vehicle quality, reliability and durability meet or exceed the expectations of our mutual customers resulting in total customer satisfaction.

B. Important: A Word About This Guide

This guide is intended for use by RV truck and commercial upfitters with expertise in their field. It, and periodically other support, is offered to assist RV and commercial truck upfitters in converting/completing RV and Commercial Truck vehicles; however, it is not intended to be a complete "how-to" authority, or a substitute for sound engineering and other judgment. The conversion and modification of vehicles requires skills and knowledge not covered in this guide. Neither General Motors, nor their representatives, assume any responsibility for the RV and commercial truck upfitters' work, including their design, materials, and workmanship.

Please direct technical questions or problems not covered in this manual to the Upfitters Integration Group Hotline **(800) 875-4742**.

C. Defining The Guideline Manual

This Upfitter Integration Best Practices Guideline Manual provides engineering recommendations and guidelines to assist the Special Vehicle Manufacturer (SVM) for all areas of the vehicle affected in the conversion process. The intent is to assure that the finished vehicle meets or exceeds Original Equipment Manufacturer (OEM) quality.

The primary focus of the Guideline Manual is the G Van, and C/K Truck. However, most recommendations are generic and can be applied to all GM models that are modified.

The recommendations and guidelines in this manual are based on documented engineering principles and a philosophy of continuous improvement. However, they also take into consideration the other factors that SVMs face, such as, cost, timing, and resource pressure.

The Upfitter Integration group recommends that all SVMs become familiar with this manual and the reference publications listed herein before starting the process. These guidelines stress vehicle safety, quality, reliability and durability. However, each SVM also has the responsibility to:

- Make sure that vehicle modifications do not reduce the vehicle's integrity.
- Comply with all Federal, State and local regulations.
- Verify that vehicle safety is maintained.
- Meet or exceed the requirements and expectations of the customer.

To simplify the appearance of this manual and make it easier to use, special symbols were created to draw your attention to important information:

Please take special note of this information.

Failure to comply may cause damage to the vehicle.

Failure to comply may result in human injury.

This procedure is not recommended.

Introduction (cont'd)

General Motors Corporation requires confidentiality in the exchange of information with Special Vehicle Manufacturers. General Motors will honor all requests for confidentiality from the SVMs and expects, in return, that all General Motors product information will be treated as confidential material.

D. Upfitter Integration Expectations

The success of the Upfitter Integration group depends on an atmosphere of communication, cooperation and trust between SVMs and General Motors. Therefore, SVMs are expected to use the Upfitter Integration resources available to them (i.e., telephone hotline, quality surveys, guideline manuals and Upfitter Integration engineering expertise). SVMs are expected to have documented processes which are understood and accepted by all. Documented processes should be in place at work stations, followed explicitly and monitored for effectiveness.

E. Continuous Improvement

! The Upfitter Integration group expects all SVMs to establish a company-wide continuous improvement process to focus on achieving and maintaining total customer satisfaction.

A continuous improvement plan should describe the processes SVMs use to implement continuous improvement and the methods used to monitor and evaluate the effectiveness of all processes.

Continuous improvement is an ongoing customer-driven process. It enables all personnel in an organization to contribute to achieving the primary business goals of optimizing quality, cost, and delivery while eliminating organizational waste

F. Key Product Characteristics

Key product characteristics are the features of a vehicle or system that have the greatest impact on total customer satisfaction. Significant variation in these areas could adversely affect safety, quality, vehicle performance, etc. Typically, key product characteristics can be seen, touched, and felt by customers.

! It is the SVM's responsibility to identify all pertinent key product characteristics.

General Motors encourages all SVMs to use documented processes for guaranteeing that all key product characteristics are maintained on a consistent basis. The process should identify measurable specifications for acceptance/rejection to maintain in-process quality control.

Therefore, the SVM should develop processes that both identify and control key product characteristics and also assure vehicle safety, quality, reliability, and durability.

Introduction (cont'd)

G. Reference Materials

Throughout this manual you will see references to the following publications:

- Federal Motor Vehicle Safety Standards (FMVSS) and Canada Motor Vehicle Standards (CMVSS)
- Society of Automotive Engineers (SAE) recommended procedures
- General Motors Service Manuals
- General Motors Truck Body Builders Manual
- General Motors Incomplete Vehicle Document
- Industrial Fasteners Institute Standards (Metric and English)
- RVIA Handbook
- NTEA Publications
- Delphi Packard Electric Connection Systems Catalog
- Delphi Packard Electric Manuals
  - — Product Engineering Handbook
  - — Wire Routing Design Quality Guidelines

H. Vehicle Weight

General Motors vehicles are designed to perform effectively within specific total weight and weight distribution ranges. The SVMs must not add weight to the vehicle which would cause the vehicle to exceed GVWR or GAWR.

- GVWR — Gross Vehicle Weight Rating is the total weight of a loaded truck. GVW is found by adding the payload weight to the curb weight of a vehicle. GVWR is the maximum allowable GVW for an individual chassis and body type.
- GAWR — Gross Axle Weight Rating is the maximum allowable GAW for either the front or rear axle.

Modifications resulting in weights which exceed the GVWR or GAWR are not approved by General Motors and may violate federal certification. If this condition occurs, the SVMs will be required to recertify compliance to all applicable federal regulations. An overweight condition would also have an adverse effect on over-all vehicle performance and customer satisfaction.

Significant variations in vehicle weight and/or distribution could affect the following areas:

Performance to FMVSS/CMVSS requirements

- Occupant safety
- Center of gravity location
- Brake performance
- Front and rear axle loads
- Front and rear spring loads
- Tire loads
- Vehicle handling and steering

One acceptable way to verify compliance to vehicle weight specifications is to weigh each vehicle model before it leaves the SVM's facility.

For more detailed information about weight, refer to the General Motors Truck Body Builders Manual.

Introduction (cont'd)

I. Serviceability

Serviceability is important to total customer satisfaction.

Ease of serviceability is most important in areas that require regularly scheduled maintenance and will reduce overall warranty expense.

The SVMs can contribute to ease of serviceability in the following ways:

- Pay special attention to regular maintenance items.
- Make sure that maintenance can be performed with common shop tools.
- Keep critical adjustments to a minimum.
- Provide adequate tool access.
- Provide a simple method to determine cause of failure with a minimum of test equipment.
- Specify reusable fasteners where possible.
- Use components that can be rebuilt to original design specifications.
- Provide aligning holes, dimples, or cutouts on mating flanges for ease of reassembly.
- Include all relevant service documentation in the vehicle's Owners Manual.

J. Torque Specifications

It is the SVM's responsibility to identify all critical fasteners and torque specifications. Assemblers should have proper tools and equipment to assure that torque specifications are met. A schedule for tool torque calibration is recommended.

Critical fasteners are defined as those fasteners where loss of function would affect (but not be limited to) the following areas:

- All regulatory conformance (Federal, State, local)
- Occupant safety
- Loss of vehicle control

The SVMs should use a documented quality control process to monitor vehicle assembly. Assembly tools and equipment must be maintained to calibrated specifications. For more information, refer to Appendix II in the Body section of this manual (General Fastener) and the Industrial Fasteners Institute Standards.

K. Special Vehicle Manufacturer's Body

- Assure that all required labels that warn, instruct or inform are located on the vehicle where they can be read easily or as required by government regulation.
- Provide the customer with a method of direct contact such as a toll free line.
- Use a customer survey process to measure customer satisfaction.
- Consult legal counsel and FMVSS/CMVSS to determine SVMs' responsibilities with respect to labeling.

Introduction (cont'd)

L. Body Sealing

! All holes or cutouts in the body must be thoroughly sealed. Self-sealing fasteners, pumpable sealers or any other approved sealing system should be used to assure that there is no water or carbon monoxide intrusion into the vehicle. See the Upfitter Integration Paint and Sealing Guideline Manual.

M. SVM Responsibility

! Compliance or implementation of recommendations in this manual are not to be construed as a substitute for verifying compliance to any federal, state or local regulations. Compliance to all standards remains the responsibility of the SVM as the final stage manufacturer.

General Motors does not take responsibility for the quality of components, methods, materials or workmanship of the SVMs, or against incidents that may result from the conversion of General Motors vehicles.

The federal government has established motor vehicle safety standards for various categories of motor vehicles and motor vehicle equipment under the provision of the National Traffic and Motor Vehicle Safety Act of 1966. The Act identifies important legal responsibilities of manufacturers, dealers, body builders, and others engaged in the manufacturing and marketing of motor vehicles and motor vehicle equipment.

Questions dealing with the specific application of the Act or the Standards to your own business should be discussed with your legal counsel. This is especially important because standards and other requirements/interpretations are subject to change by the government agency in charge: the National Highway Traffic Safety Administration (NHTSA).

New standards and amendments issued by the National Highway Traffic Safety Administration will appear in the Federal Register from time to time. You may obtain the Federal Register through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

It is also the responsibility of the SVM to:

- Assure that all required labels that warn, instruct or inform are located on the vehicle where they can be easily read. Consult legal counsel and the FMVSS/CMVSS to determine SVM responsibility with respect to labeling.
- Provide the customer with a method of direct contact such as a toll free line.
- Use a customer survey process to measure customer satisfaction.
- Maintain a clean and well-organized manufacturing facility.
- Road test vehicles to expose discrepancies in the design and build processes.

N. Responsibility For Complete Vehicle Performance

General Motors performs extensive testing on all vehicles described in this manual. Major changes to a complete vehicle or the installation of a body by an upfitter on an incomplete vehicle chassis will affect vehicle performance.

! It is the responsibility of the Special Vehicle Manufacturer to validate final completed vehicle performance. Total vehicle system performance tests may be required. The test schedule must reflect the type of vehicle system conditions to which the completed vehicle will be subjected to and must also include consideration of all aspects of performance, such as durability, ride and handling.

Introduction (cont'd)

O. Incomplete Vehicle Document

An Incomplete Vehicle Document is supplied with each incomplete vehicle. It provides instructions for intermediate and final stage manufacturers to use in determining conformity to applicable Federal Motor Vehicle Safety Standards (FMVSS). This document also includes instructions which must be followed to assure that EPA and California emission certification requirements are met.

In addition, General Motors provides a GM Body Builders Manual for the Special Vehicle Manufacturer to use in the completion of the vehicle. In no case should any SVM alterations affect the function, physical or mechanical properties, environment or vital space clearance of the components, assemblies, or systems of the incomplete vehicle.

The Incomplete Vehicle Document also specifies that the center of gravity location be within certain limits for proper brake balance, and may be more restrictive than the data mentioned above. The SVM must use all appropriate data.

For further assistance, contact General Motors by calling the Upfitter Integration Hotline at **1-800-875-4742** or visit the upfitter web site: **www.gmupfitter.com**.

P. Characteristics Of A Compliance Control System

The following recommendations are suggested as guidelines for developing a compliance control system:

- Assign a designated person to be responsible for the interpretation and compliance to FMVSS, CMVSS and other government regulations.
- Use a documented process to assure compliance with FMVSS and CMVSS regulations. Include a formal analysis in writing with appropriate document signoff.
- Keep on file in the Engineering Department a formal engineering change control system, which documents product and process changes.

Perform a design and process PFMEA (Potential Failure Mode Effects and Analysis) on any design modifications made to the OEM cab/chassis to assure reliability and build consistent with all OEM specifications and guidelines.

WARNING

Perform a weight and balance analysis on each model vehicle to assure compliance to OEM specifications. Never exceed OEM GVWR or GAWR specifications. Refer to the “Incomplete Vehicle Document” section for additional data. The significant elements for weight and balance analysis are:

- — OEM base vehicle
- — SVM conversion (including all permanently attached equipment)
- — All fluids (at full levels) required to operate the vehicle
- — Occupant (driver and all other belted positions weights
- — Maximum cargo capacity

- Provide manufacturing and assembly personnel with engineering drawings and assembly procedures.

Introduction (cont'd)

P. Characteristics Of A Compliance Control System *(continued)*

- Use a final inspection process and include the documented results with the vehicle records. The results should have clear accept/reject criteria, and should include the following systems:
  - — Engine cooling
  - — Engine and transmission performance, including downshift and PRNDL indexing
  - — High idle RPM setting and full throttle pedal travel
  - — Fuel system leaks
  - — Exhaust shielding and leaks
  - — Body/cab leaks
  - — Electrical performance
  - — Brake performance
  - — Parking brake performance
  - — Ride/handling/steering
  - — Vehicle vibrations and noise
  - — Heater/air conditioning function and leak test
  - — A/C recharge capacity labels
  - — Paint code

Q. Noise Emission Standards For Transportation Equipment: Medium and Heavy Trucks – 40CFR Part 205

The U.S. Environmental Protection Agency (EPA) has established noise emission standards applicable to vehicles manufactured after January 1, 1978, under the provisions of the Noise Control Act of 1972 (in general, vehicles in excess of 10,000 pounds GVWR capable of transportation of property on a street or highway). The standard provides that vehicles manufactured after January 1, 1988, must conform to a maximum 80 dBA level.

The Act and the standards impose legal obligations on vehicle manufacturers and subsequent manufacturers. Questions about the standard's definition of a "vehicle" or the specific application of the Act or its standards to your own business should be discussed with your legal counsel. This is especially important because of the EPA's broad definition of a "vehicle".

Standards or interpretations of such standards are subject to change by the EPA. New standards or amendments issued by the Environmental Protection Agency appear in the Federal Register from time to time. You may obtain the Federal Register through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Introduction (cont'd)

R. Federal Regulations – Tires

The National Highway Traffic Safety Administration has issued regulations dealing with tire identification and record keeping which became effective May 22, 1971. Under these regulations important legal responsibilities are imposed upon tire manufacturers, brand name owners, retreaders, distributors and dealers, and motor vehicle manufacturers and dealers, to maintain and/or report certain information concerning tires. This information will be used to facilitate interest of safety. If you have any questions concerning the application of these regulations to your business, we suggest you consult with your legal counsel.

In order for General Motors to meet its responsibility under these tire regulations we have a record of the tires on each vehicle we shipped to you. If you do not change a tire on a General Motors vehicle, it is important that you make sure that it is reshipped with the same tires that were on it when the vehicle was received by you. This means that any tire which you remove from a vehicle during the course of your work should be put back on the same vehicle.

If you replace a tire on a General Motors vehicle, you are responsible for maintaining records of the vehicle identification number (VIN) and the vehicle owner to allow notification, through your records, if tire problems are found.

In case you should receive a defect notification from a tire manufacturer concerning tires which you installed on a vehicle returned to us, you may forward it to us so that we can send it to the vehicle owner whose name will appear on our records.

S. Personnel And Process Controls

The General Motors vehicle systems are highly complex in their operation and componentry, and extremely sensitive to SVM alterations and/or additions. Therefore, to assure vehicle system quality in every vehicle, a climate of constant and careful attention to processing details must be established. Doing so will aid in the production of problem free vehicles, the promotion of customer satisfaction and reduction of warranty expense.

General Motors recommends that all personnel involved in the design, installation and testing of the vehicle systems thoroughly understand the information contained in this manual. Additionally, it is suggested that the SVM adopt the practices and procedures described in this manual and appoint a qualified individual to coordinate all activities related to the processing of the vehicle systems.

Ideally, the SVM's vehicle coordinator would have a combination of technical, communication and administrative skills that would enable him/her to perform several important functions. These functions would include implementing, monitoring and controlling all vehicle processes including assembly, installation, repair, maintenance, quality control and evaluation; identifying problems and recommending solutions; coordinating activities between departments and groups; gathering, interpreting and disseminating necessary technical and administrative data and other information.

Introduction (cont'd)

T. General Information

In the event the reader should conclude that the General Motors recommendations in this manual conflict with the ANSI/RVIA standards or with any recommendations and/or directions furnished with any components that the SVM installs, the SVM should contact the General Motors Upfitter Integration group for clarification and/or guidance. (**1-800-875-4742**).

No recommendations in this manual knowingly conflict with any FMVSS, CMVSS, state and/or local regulations. In the event it is deemed there may be a conflict, the federal, state and/or local regulations shall take precedence.

The guidelines and information in this manual are not intended to supplant any standards, instructions, requirements, directions, etc., that are included in the following General Motors documents and/or manuals:

- Incomplete Vehicle Document
- GM Body Builders Manual(s)
- Service Manual(s)
- Driveability, Emissions and Electrical Diagnosis Manual(s)

In the event the reader should conclude that there is a conflict, the information contained in the above documents shall take precedence.

WARNING

It is the SVM's responsibility to maintain the structural integrity of the OEM vehicle body. To assure this, SVMs should conduct appropriate testing and engineering analyses when modifying any structure of the vehicle's body.